New Hampshire Volunteer Lake Assessment Program

2003 Interim Report for Messer Pond New London

NHDES
Water Division
Watershed Management Bureau
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NEW HAMPSHIRE DEPARTMENT OF Environmental Services

OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **MESSER POND, NEW LONDON,** the program coordinators have made the following observations and recommendations:

Thank you for your continued hard work sampling the lake/pond this season! Your monitoring group sampled **four** times this season! As you know, with multiple sampling events each season, we will be able to more accurately detect changes in water quality. Keep up the good work!

We would like to encourage your monitoring group to participate in the DES Weed Watchers program, a volunteer program dedicated to monitoring the lakes and ponds for the presence of exotic weeds.

This program only involves a small amount of time during the summer months. Volunteers survey their waterbody once a month from June through September. To survey, volunteers slowly boat, or even snorkel, around the perimeter of the waterbody and any islands it may contain. Using the materials provided in the Weed Watchers Kit, volunteers look for any species that are of suspicion. After a trip or two around the waterbody, volunteers will have a good knowledge of its plant community and will immediately notice even the most subtle changes. If a suspicious plant is found, the volunteers will send a specimen to DES for identification. If the plant specimen is an exotic, a biologist will visit the site to determine the extent of the problem and to formulate a plan of action to control the nuisance infestation.

If you would like to help protect your lake or pond from exotic plants, contact Amy Smagula, Exotic Species Program Coordinator, at 271-2248 or visit the Weed Watchers web page at www.des.state.nh.us/wmb/exoticspecies/survey.htm.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

  Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration measured in the water gives an estimation of the algal concentration or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 mg/m^3.**

  The current year data (the top graph) show that the chlorophyll-a concentration ***decreased greatly*** from July to August. The chlorophyll-a concentration in July was ***slightly greater than*** the state mean, while the concentration in August was ***much less*** than the state mean. (It should be noted that a chlorophyll sample was not collected in June. The chlorophyll sample submitted to the laboratory in September was not analyzed since the proper sampling procedures were not followed.)

  The historical data (the bottom graph) show that the 2003 chlorophyll-a mean is ***less than*** the state mean. It is worthy to note that the 2002 annual mean chlorophyll is the second highest mean since monitoring began.

  Overall, visual inspection of the historical data trend line (the bottom graph) shows a ***variable*** in-lake chlorophyll-a trend, meaning that the concentration has ***fluctuated*** since monitoring began in 1996.

  While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Algal concentrations may increase with an increase in nonpoint sources of phosphorus loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Therefore, it is extremely important for volunteer monitors to continually educate residents about how activities within the watershed can affect phosphorus loading and lake/pond quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 (Appendix B) lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

  Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

  The current year data (the top graph) show that the in-lake transparency ***increased slightly*** from June to July, ***decreased slightly*** from July to August, and then ***remained stable*** from August to September. The transparency on each sampling event was ***less than*** the state mean.

  Overall, visual inspection of the historical data trend line (the bottom graph) shows a ***relatively stable*** trend for in-lake transparency. Specifically, the mean annual transparency has ranged from approximately **2.5** to **4.0 meters** since monitoring began in 1996.

  Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from DES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

  Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is**

11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.

The current year data for the epilimnion (the top inset graph) show that the phosphorus concentration ***increased very gradually*** each month from June to September. The phosphorus concentration in June was ***approximately equal to*** the state median, while the concentration in July, August, and September was ***slightly greater than*** the state median.

The historical data show that the 2003 mean epilimnetic phosphorus concentration is ***slightly greater than*** the state median.

The current year data for the hypolimnion (the bottom inset graph) show that the phosphorus concentration ***decreased*** from July to September. (A hypolimnetic phosphorus sample was not submitted to the laboratory in June or August.) The phosphorus concentration in July was ***greater than*** the state median, while the concentration in September was ***slightly less than*** the state median.

The historical data show that the 2003 mean hypolimnetic phosphorus concentration is ***slightly greater than*** the state median.

Overall, visual inspection of the historical data trend line for the epilimnion and the hypolimnion show a ***variable*** total phosphorus trend, which means that the concentration has ***fluctuated*** monitoring began in 1996.

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

TABLE INTERPRETATION

- **Table 2: Phytoplankton**

  Table 2 (Appendix B) lists the current and historical phytoplankton species observed in the lake/pond. The dominant phytoplankton species observed this year were ***Chrysosphaerella*** and ***Dinobryon,*** which are both **golden-brown algae.**

  Phytoplankton populations undergo a natural succession during the growing season (Please refer to the "Biological Monitoring Parameters" section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire's less productive lakes and ponds.

- **Table 4: pH**

  Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

  pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is **6.5**, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to the "Chemical Monitoring Parameters" section of this report.

  The mean pH at the deep spot this season ranged from **6.06** in the hypolimnion to **6.56** in the epilimnion, which means that the water is ***slightly acidic.*** When organic matter near the lake bottom is decomposed, acidic by-products are produced, which likely explains the lower pH (meaning higher acidity) in the hypolimnion.

  Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

- **Table 5: Acid Neutralizing Capacity**

  Table 5 (Appendix B) presents the current year and historical epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

  Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. The mean ANC value for New Hampshire's lakes and ponds is **6.7 mg/L**, which indicates that many lakes and ponds in the state are "highly sensitive" to acidic inputs. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

  The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) continues to remain ***less than*** the state mean. Specifically, the mean ANC was **5.40 mg/L**, which indicates that the pond is ***critically sensitive*** to acidic inputs (such as acid precipitation).

- **Table 6: Conductivity**

  Table 6 (Appendix B) presents the current and historical conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. The mean conductivity value for New Hampshire's lakes and ponds is **62.1 uMhos/cm**. For a more detailed explanation, please refer to the "Chemical Monitoring Parameters" section of this report.

  The conductivity has ***increased*** in the lake/pond and inlets since monitoring began. In addition, the in-lake conductivity is ***much greater than*** the state mean. Typically, sources of increased conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity.

  We recommend that your monitoring group conduct stream surveys and storm event sampling along the inlet(s) with elevated conductivity (particularly, **Brown Inlet** and **Nutter Inlet**) so that we can determine what may be causing the increases.

  For a detailed explanation on how to conduct rain event and stream surveys, please refer to the 2002 VLAP Annual Report "Special Topic Article", or contact the VLAP Coordinator.

- **Table 8: Total Phosphorus**

  Table 8 (Appendix B) presents the current year and historical total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  Bog Road, Brown Inlet, County Rd Inlet, Nutter Inlet, and the **Outlet** were sampled for phosphorus this season. The phosphorus concentration in **Brown Inlet** and **Nutter Inlet** was elevated this season.

  Specifically, the phosphorus concentration in the **Nutter Inlet** sample in June was **33 ug/L** and in September was **36 ug/L**; however, the turbidity in the June sample was *not* elevated (0.82 NTUs), which suggests that the stream bottom was *not* disturbed while sampling. (Unfortunately, the September turbidity sample was rejected for analysis.)

When the stream bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting samples in the inlets, please be sure to sample where there the stream is flowing and where the stream is deep enough to collect a "clean" sample.

The phosphorus concentration in the **Brown Inlet** sample collected in September was **83 ug/L**. (Unfortunately, the September turbidity sample was rejected for analysis.)

Brown Inlet and **Nutter Inlet** have had a history of ***elevated*** and ***fluctuating*** total phosphorus concentrations. We recommend that your monitoring group conduct stream surveys and storm event sampling along these inlets so that we can determine what may be causing the increases.

For a detailed explanation on how to conduct rain event and stream surveys, please refer to the 2002 VLAP Annual Report "Special Topic Article", or contact the VLAP Coordinator.

- **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**
  Table 9 (Appendix B) shows the dissolved oxygen/temperature profile(s) for the 2003 sampling season. Table 10 (Appendix B) shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

  The dissolved oxygen concentration was ***low in the hypolimnion*** at the deep spot of the lake/pond. As stratified lakes/ponds age, and as the summer progresses, oxygen becomes ***depleted*** in the hypolimnion (the lower layer) by the process of decomposition. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake/pond where the water meets the sediment. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion **(as it was this season and in many past seasons)**, the phosphorus that is normally bound up in the sediment may be re-released into the water column.

  The ***low*** oxygen level in the hypolimnion is a sign of the lake's/pond's ***aging*** and ***declining*** health.

This year the DES biologist conducted the temperature/dissolved oxygen profile in ***July.***

We recommend that the annual biologist visit for the 2004 sampling season be scheduled during *June* so that we can determine if oxygen is depleted in the hypolimnion *earlier* in the sampling season. (Please note that a June profile has not been collected in the pond since monitoring began.)

- **Table 11: Turbidity**

  Table 11 (Appendix B) lists the current year and historical data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to the "Other Monitoring Parameters" section of this report for a more detailed explanation.

  The turbidity in the deep spot and inlet samples was ***relatively low*** this season.

- **Table 12: Bacteria (*E.coli*)**

  Table 12 lists the current year data for bacteria *(E.coli*) testing. *E. coli* is a normal bacterium found in the large intestine of humans and other warm-blooded animals. *E.coli* is used as an indicator organism because it is easily cultured and its presence in the water, in defined amounts, indicates that sewage **MAY** be present. If sewage is present in the water, potentially harmful disease-causing organisms **MAY** also be present.

  In June, the **Webster** location was sampled for *E.coli*. The result was less than 10 counts per 100 mL, which is ***low***.

  If you are particularly concerned about bacteria levels in this location, we recommend that your monitoring group conduct *E.coli* sampling next season on a weekend during heavy beach use or after a rain event. Since *E.coli* die quickly in cool pond waters, testing is most accurate and most representative of the health risk to bathers when the source (humans, animals, or waterfowl) is present.

DATA QUALITY ASSURANCE AND CONTROL

Sample Receipt Checklist:

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did a ***good*** job when collecting samples this season! Specifically, the members of your monitoring group followed most of the proper field sampling procedures when collecting and submitting samples to the laboratory. However, the laboratory staff did identify of few aspects of sample collection that the monitors could improve upon.

- **Holding Time:** The **pH, ANC, turbidity, conductivity, and chlorophyll-a** samples that were collected by your monitoring group on the **September** sampling event were more than 48 hours old. Therefore, these samples were rejected for analysis.

  Please remember that samples that are more than 48 hours old will be rejected for analysis since the integrity of the samples will have degraded by this time. (And, please remember that *E.coli* samples that are more than 24 hours old will not be accepted by the laboratory for analysis.)

- **Complete Sample Sets:** Please remember to collect one "big white" bottle (pH, ANC, turbidity, conductivity), **and** one "small brown" bottle (phosphorus) at each inlet and deep spot location on each sampling event. In addition, please collect a chlorophyll sample in the "big brown" bottle on each sampling event. Collecting a complete set of samples on each sampling event will allow us to better determine the quality of the lake/pond.

NOTES

- **Monitor's Note (7/14/03):** Brown brook no flow; no sample taken
  (8/3/03): Significant flow due to recent rains, rain while sampling

- **Biologist's Note (6/8/03):** Bog Rd. site not previously identified or sampled. No chlorophyll submitted, confusion on sampling techniques. No total phosphorous submitted for hypolimnion.

(8/3/03): Harris' house new sampling location. Also wrote in Bog Rd. although a site used in the past.

(9/6/03): Samples delivered past the 48 hour limit, only total phosphorous samples were tested, as they were kept in a refrigerator for the duration.

USEFUL RESOURCES

Acid Deposition Impacting New Hampshire's Ecosystems, ARD-32, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/ard/ard-32.htm.

Camp Road Maintenance Manual: A Guide for Landowners. KennebecSoil and Water Conservation District, 1992, (207) 287-3901.

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm.

Impacts of Development Upon Stormwater Runoff, WD-WQE-7, NHDES Fact Sheet, (603) 271-3503, or www.des.state.nh.us/factsheets/wqe/wqe-7.htm

Lake Protection Tips: Some Do's and Don'ts for Maintaining Healthy Lakes, WD-BB-9, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-9.htm.

Management of Canada Geese in Suburban Areas: A Guide to the Basics, Draft Report, NJ Department of Environmental Protection Division of Watershed Management, March 2001, www.state.nj.us/dep/watershedmgt/DOCS/BMP_DOCS/Goosedraft.pdf.

Proper Lawn Care In the Protected Shoreland, The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm.

Road Salt and Water Quality, WD-WMB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/wmb/wmb-4.htm.

Sand Dumping - Beach Construction, *WD-BB-15*, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm.

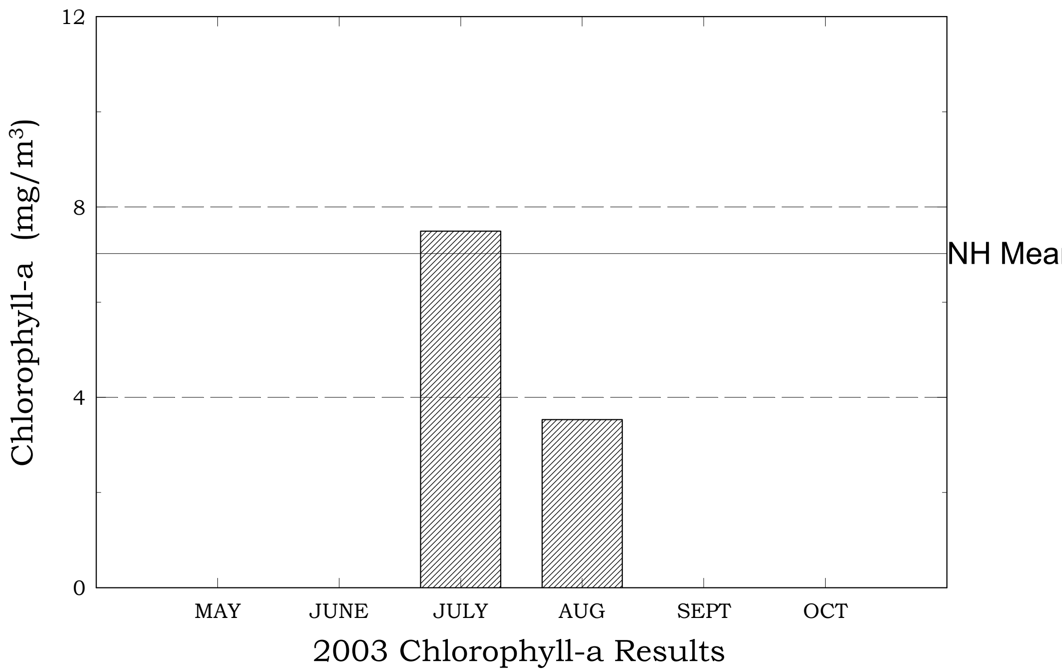
Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-4.htm.

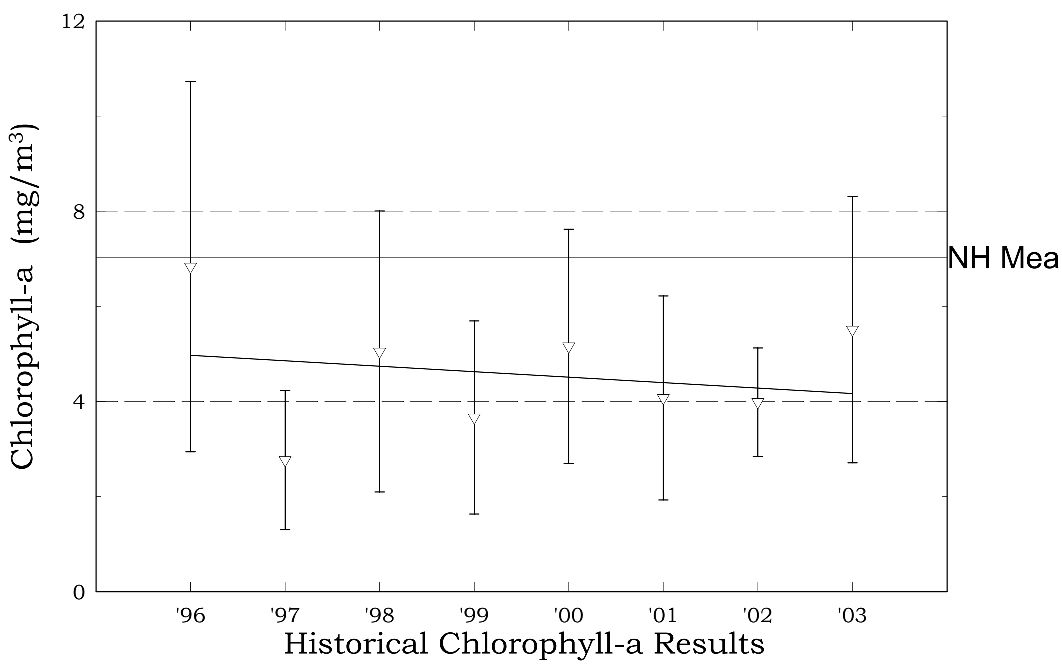
APPENDIX A

GRAPHS

Messer Pond, New London

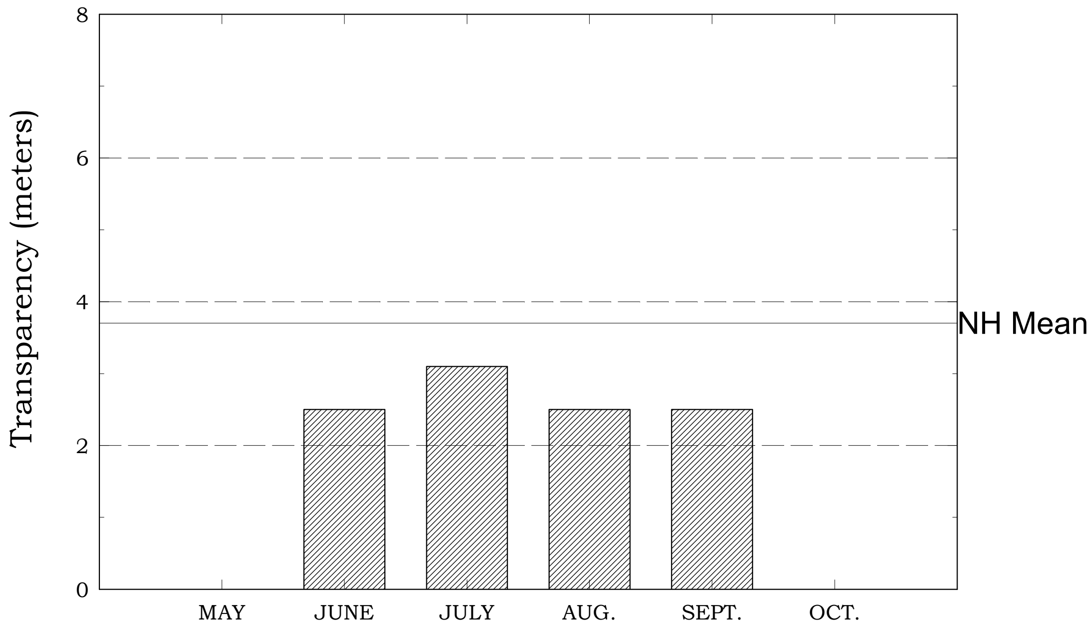
Figure 1. Monthly and Historical Chlorophyll-a Results



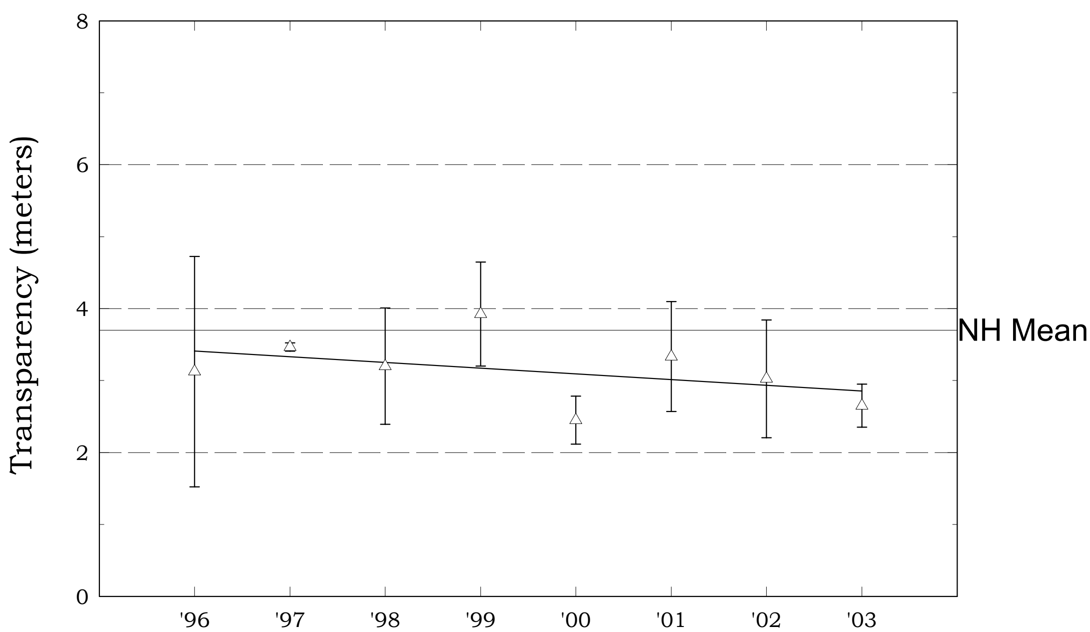


Messer Pond, New London

Figure 2. Monthly and Historical Transparency Results



2003 Transparency Results



Historical Transparency Results

Messer Pond, New London

Figure 3. Monthly and Historical Total Phosphorus Data.